

THE WEATHER AND CIRCULATION OF APRIL 1963

Continued Warm East of the Continental Divide and Cool to the West

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1. INTRODUCTION

The temperature regime in the United States in April was a continuation of the March pattern [1], with relatively warm weather in eastern and central sections and below normal temperatures to the west. This persistence can be measured in terms of the surface temperature anomaly classes customarily used in extended forecasting. Of 100 nearly evenly distributed cities over the United States, 83 did not have a temperature change of more than one class. This compares with a 15-yr. normal of 65 cities with temperatures in this category [2]. Major differences from March were an increase in size and intensity of the cooler than normal area and a decrease in intensity and extent of the above normal temperature area. Persistence of the same regime brought record coolness and rainfall amounts for April to parts of the Far West and record high monthly temperatures to portions of the Southern Plains.

Precipitation amounts in April were in sharp contrast with March amounts in some areas, but in other sections precipitation showed considerable local persistence from March to April. Most of the Ohio Valley received a respite from the floods of March, but in Tennessee and the adjacent parts of the States immediately to the south heavy rains were again reported (in only slightly diminished amounts). Much of Texas received welcome rains that broke a prolonged drought, but at the same time, the Panhandle and the coastal area remained extremely dry. Parts of the Northern Plains received more than twice the normal rainfall in April where dry conditions had prevailed in March. A large section of California received very heavy precipitation (up to 14 in.) which helped to alleviate the precipitation shortage of the winter season in that area. In contrast, record or near record rainfall deficiencies were reported in a strip from Colorado through West Virginia to the east coast.

2. MONTHLY MEAN CIRCULATION

The predominant feature of the 700-mb. mean flow during April (fig. 1) was the continuation of the same regime over North America and nearby oceans that began in March. The positions of the upper-level troughs near

North America in April were little changed from the previous month [1]. Just off the west coast the negatively tilted trough was only slightly west of its March position and oriented very similarly (fig. 1 of [1]). The western Atlantic trough was 5° to 10° longitude west of its March location and also similarly oriented. The ridge over the United States between these two troughs was more pronounced than in March, yet 700-mb. heights were only 60 ft. above normal in the strongest part of the ridge.

The Northwest Territories of Canada and the Baffin Island area had the greatest 700-mb. height change from March to April, as a 300-ft. positive anomaly center over Baffin Island in April replaced a 440-ft. negative anomaly in the same area during March.

Across the central and western Atlantic Ocean the mean jet maximum at 700 mb. was very close to its normal position (fig. 2A) but with speeds as much as 7 m.p.s. stronger than normal (fig. 2B) as a result of the deep Low near Newfoundland. Heights of the 700-mb. level over the eastern Atlantic were all below normal south of Iceland, but the gradient of the anomalous flow was quite weak so that the flow pattern was similar to the normal [3] with the exception that normally weak anticyclonic flow over the British Isles was replaced by cyclonic flow this April.

The strongest anomalous height gradient in the Northern Hemisphere during April at 700 mb. was from the Arctic Ocean in the vicinity of Novaya Zemlya south-southeastward into USSR. This flow reflects the reversal of the normal trough-ridge pattern in the surrounding regions. The normal ridge from eastern India extending north-northeastward just west of Lake Baikal to the Arctic Basin [3] was replaced this month by cyclonic flow with a 320-ft. negative height anomaly centered near 70° N., 100° E. At the same time, the normal trough over Scandinavia was replaced this April by a ridge and a 260-ft. positive height anomaly centered about 65° N., 35° E. Directly south of the Scandinavian ridge, below normal heights were associated with a closed Low over the Black Sea and the trough to the south over the eastern Mediterranean. Reference again to figure 2 shows that in eastern Asia the position and strength of the strongest belt of 700-mb. winds were fairly close to normal during April this year.

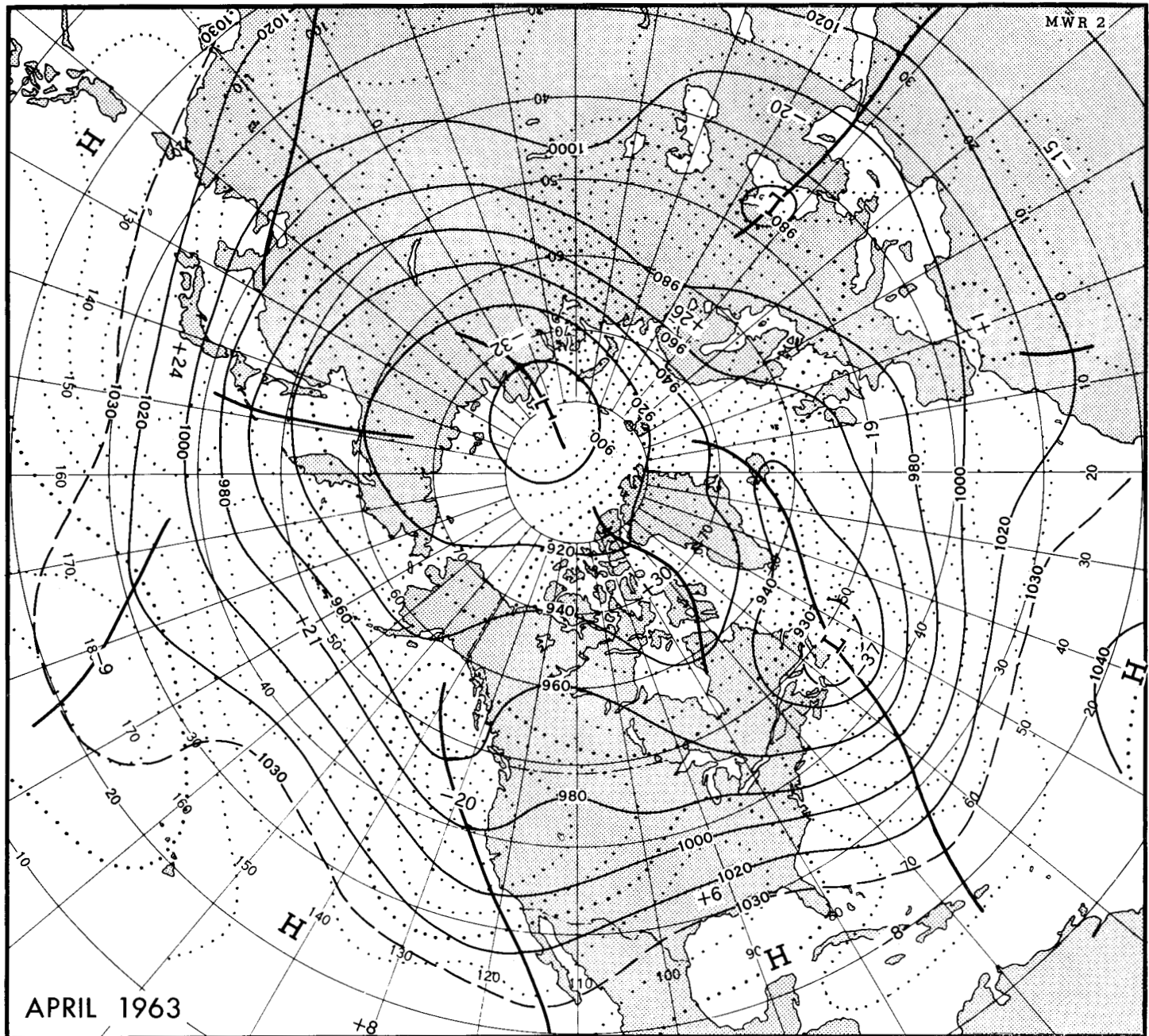


FIGURE 1.—Mean 700-mb. contours (solid) and height departures from normal (dotted), both in tens of feet, for April 1963.

The main band of westerlies in the Pacific was displaced to the north of its usual position with the major jet path paralleling the normal jet for April (fig. 2). Wind speeds were below normal over much of the Pacific as a result of the positive 700-mb. height anomalies at high latitudes with a 90-ft. negative height anomaly center at lower latitudes.

3. MONTHLY TEMPERATURES

Figure 3A shows that average temperatures for April were below normal in most of the Far West. Extreme departures of 7.5° F. at Red Bluff, Calif., and 6.5° F. at Las

Vegas and Ely, Nev., equalled or exceeded previous April temperature records at those stations. These below normal temperatures were associated with below normal 700-mb. heights and frequent incursions of cool maritime air. It was the persistence of the cool regime through the month rather than a few large extremes that produced the record coolness. Few daily minimum temperature records were established this April.

The warmest area relative to normal in the Southern Plains was located in a region of above normal 700-mb. heights and southwesterly anomalous flow. Here too, record temperature departures for April were established

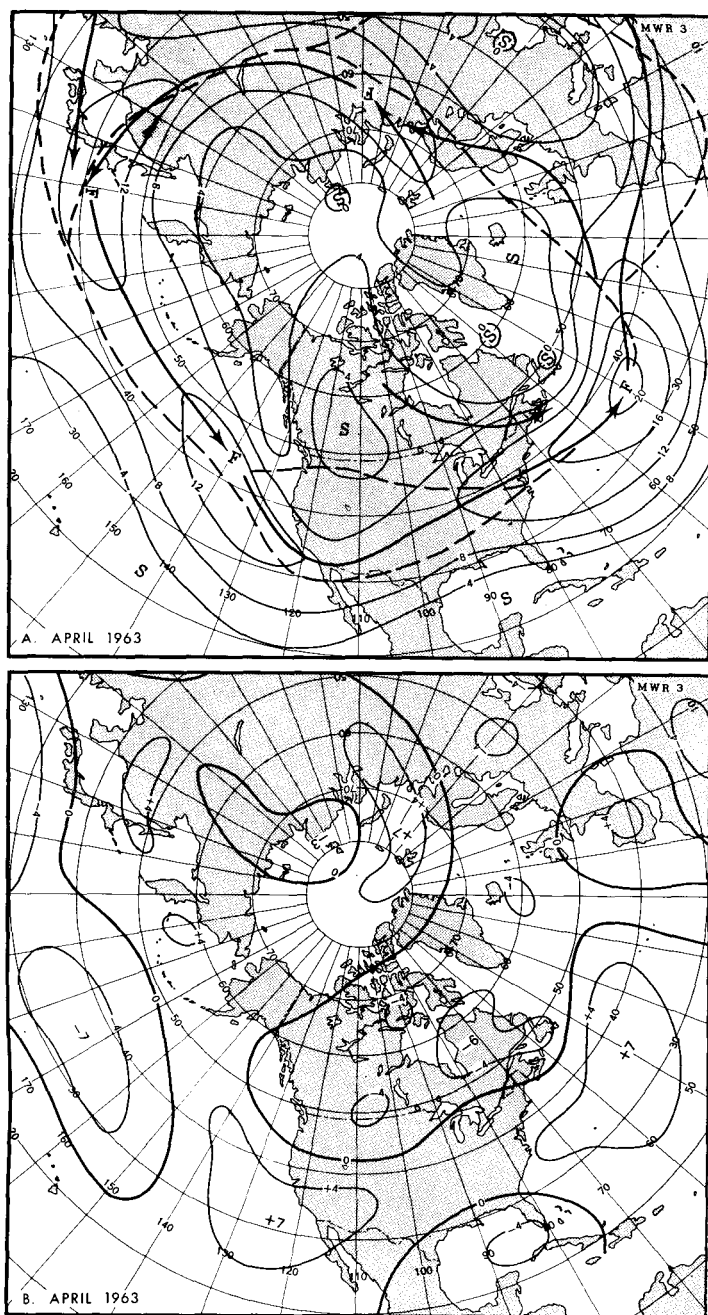


FIGURE 2.—(A) Mean 700-mb. isotachs in meters per second for April 1963. The heavy solid arrows indicate observed axes of maximum wind speed, while dashed lines show the normal axes for April. (B) Departure from the normal 700-mb. wind speed in meters per second for April 1963.

by a day-to-day continuation of the same regime. For instance, Houston, Tex. reported the warmest April of record while no daily records for the station were broken. The above normal temperatures in the Southeast were also in an area of above normal 700-mb. heights, but the warmth of the North Central Section, where 700-mb. heights were slightly below normal, can best be attributed to the southerly anomalous flow aloft. The above normal temperatures from southern New York to eastern North Carolina with below normal 700-mb. heights and a fairly

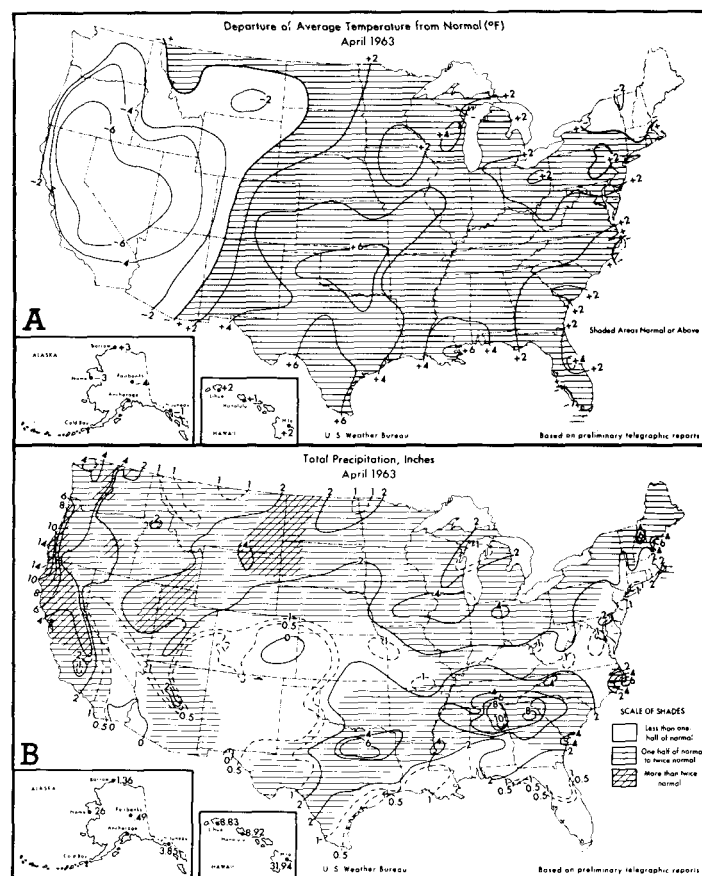


FIGURE 3.—(A) Departure of average temperature from normal (°F) and (B) percentage of normal precipitation for April 1963 (from [5]).

strong northerly anomalous flow (fig. 1) are somewhat difficult to explain. One possible explanation was the abundance of sunshine in this area. Sunshine duration reports from 14 stations from New York to eastern North Carolina (see table 1) showed an average of about 9 percent above normal sunshine during April. Every one of the stations in this area for which both normal [4] and current sunshine data are available reported above normal sunshine.

TABLE 1.—Hours of sunshine recorded at some eastern stations in April 1963

Station	Hours of sunshine recorded	Percent of possible	Normal percent of possible
Baltimore, Md.	296	75	59
Boston, Mass.	248	62	57
Raleigh, N.C.	259	66	64
Concord, N.H.	235	58	53
Atlantic City, N.J.	264	66	59
Trenton, N.J.	284	71	59
Binghamton, N.Y.	286	71	44
New York, N.Y.	282	71	61
Harrisburg, Pa.	265	67	58
Pittsburgh, Pa.	218	55	50
Providence, R.I.	250	63	58
Lynchburg, Va.	273	69	61
Norfolk, Va.	265	67	63
Parkersburg, W. Va.	235	59	50
Average		65.7	56.9

4. MONTHLY PRECIPITATION

The sharp trough parallel to the west coast (fig. 1) gave very heavy precipitation to most of northern California and the Oregon coast (fig. 3B). Frequent storm activity spread this precipitation eastward to sections of the Rocky Mountains and parts of the Northern Plains where amounts were more than twice normal. Across the more northern Midwest and Eastern States the passage of these storms gave about normal rainfall.

The heavy rain from Texas into Tennessee and the western Carolinas, while occurring under the mean monthly ridge, was associated primarily with the high frequency of fronts in this region (fig. 4). The weekly variation of the circulation (section 5) will best explain the precipitation regime in South Central and Southeastern States.

Precipitation was markedly deficient in portions of the Central Plains and central and southern Rocky Mountain States (fig. 3B) as fairly strong west-southwesterly flow (fig. 1) produced a "rain shadow" effect. A trace of rain at Goodland, Kans., and Pueblo, Colo., and 0.03 in. at Denver, Colo., all established record low rainfall amounts for April. Several other sections of the United States including Washington, D.C., had record or near record rainfall shortage in April. Parts of Florida and other Gulf Coast States also experienced drought conditions.

The persistent mean trough west of Hawaii (fig. 1) and southerly anomalous cyclonic flow over the Islands continued the above normal rainfall in that area [1]. Hilo, with a monthly total of 31.94 in. which was 20.02 in. above normal, reported by far the largest amount, but several stations in Hawaii also reported very heavy rains.

5. INTRA-MONTH VARIATIONS OF CIRCULATION AND WEATHER OVER NORTH AMERICA

Although the areas of the United States that show the

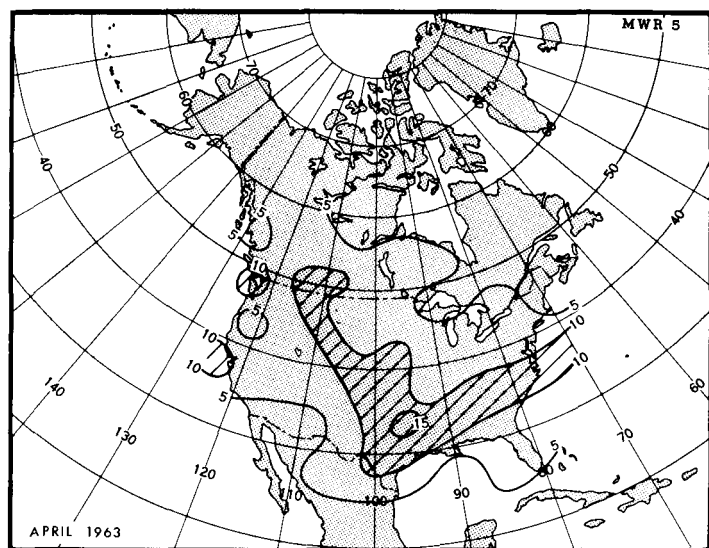


FIGURE 4.—Number of days with fronts in equal-area (66,000 n.mi.²) quadrilaterals for April 1963

greatest monthly extremes in figure 3A maintained the same temperature regime through all of April, other areas had considerable variation of temperature. The variation in the Northeast was most pronounced with changes in the temperature regime each week.

The average circulation over the United States during the first week of April was represented by a ridge in the

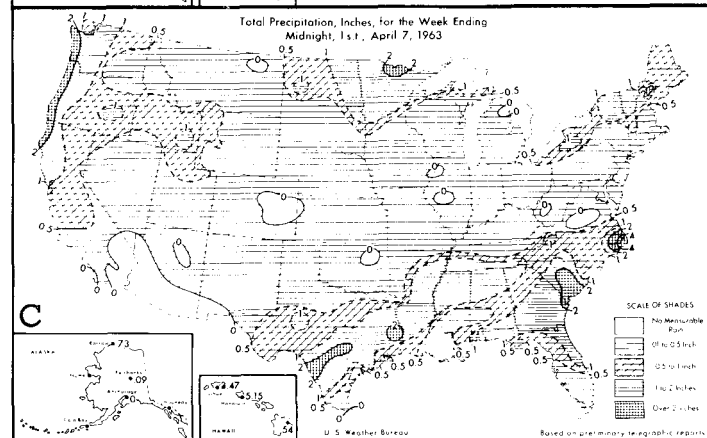
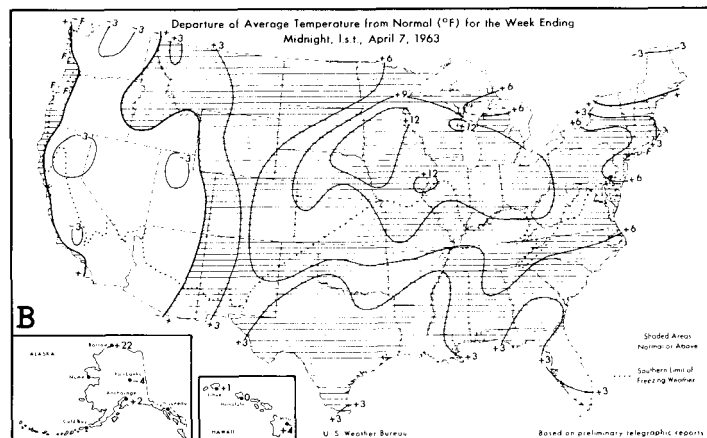
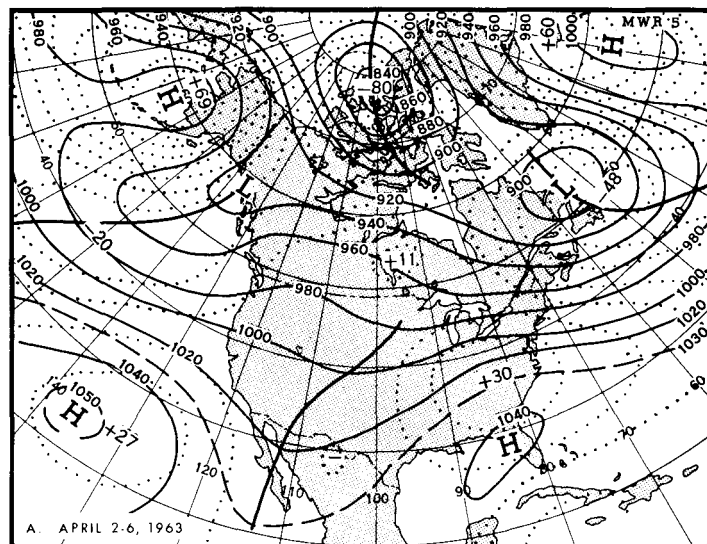
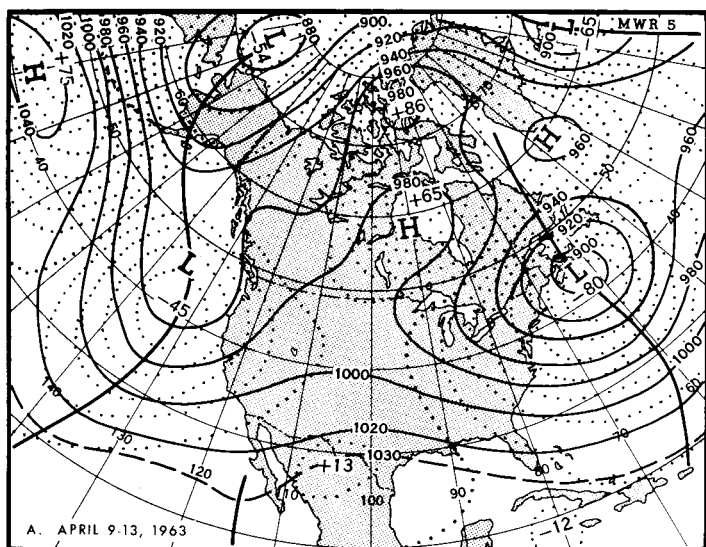


FIGURE 5.—(A) 700-mb. contours (solid) and height departures from normal (dotted) both in tens of feet, for April 2-6, 1963. (B) Surface temperature departure from normal (°F.) and (C) total precipitation (in.) for week ending April 7, 1963 (from [5]).

East and a ridge in the West and a trough from Minnesota southwestward to Arizona (fig. 5A). Above normal 700-mb. heights in the trough and eastern ridge resulted in above normal temperatures for all areas east of the Rocky Mountains with only moderately cool conditions in much of the Far West (fig. 5B). The Northwest coast, parts of the North Central States, and some of the North-

east received 1 to 2 in. of rain in the first week of April (fig. 5C).

Rapid retrogression of high-latitude anticyclonic activity (blocking) from the Iceland area to northern Canada (note the shift of the large positive 700-mb. height anomaly between figs. 5A and 6A) resulted in a strong north-south ridge over central North America during the second week



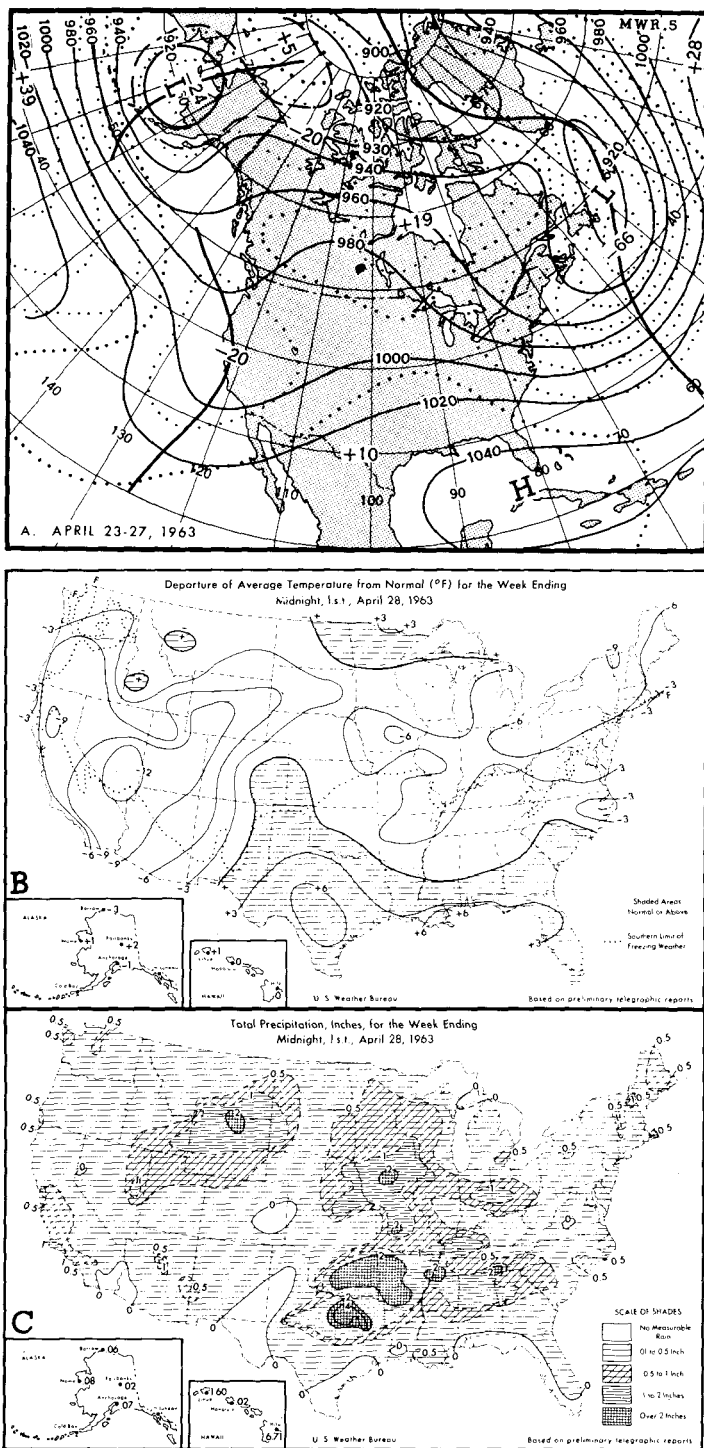


FIGURE 8.—(A) 700-mb. contours (solid) and height departures from normal (dotted), both in tens of feet, for April 23–27, 1963. (B) Surface temperature departure from normal (°F.), and (C) total precipitation (in.) for week ending April 28, 1963 (from [5]).

of April with a deep trough off each coast. This circulation brought cooling to northeastern United States, but relatively warm air persisted over the central two-thirds of the Nation (fig. 6B). West Coast states and Nevada continued to have mostly below normal temperatures. A very strong surface high pressure system formed over

Baffin Island early in the week, accompanying the retrogression mentioned above, and as the week progressed this large High moved slowly southward with the center reaching Iowa on the 14th. This influx of dry continental air into the United States during the week caused most of the Nation to have little or no precipitation (fig. 6C). However, there was unusually heavy precipitation in northern California and southwestern Oregon associated with persistent offshore cyclonic activity that became rather intense late in the week.

Progression of the deep trough that had been off the west coast into the United States and amplification of the Pacific ridge (fig. 7A) resulted in quite low temperatures (fig. 7B) for almost the western half of the Nation during the third week of April. A 0° F. minimum at Ely, Nev., on April 21, resulted in an average temperature 29° F. below normal for the station that day. The eastern half of the country was extremely warm this week. A record-breaking 95° F. maximum at Dodge City, Kans., on the 15th contributed to the +23° F. anomaly at that station for the day. As in the first week the eastward-moving trough gave areas of heavy precipitation to some of the eastern half of the United States, but figure 7C shows the heavy rain areas to be widely scattered and quite small. Considerable heavy precipitation continued in many Western States this week, however a large area of no rainfall was present to the lee of the southern Rockies and southward into West Texas, New Mexico, and much of Arizona.

In the final week of April, a large 700-mb. ridge again dominated the United States with one trough along the west coast and another trough well off the east coast over the Atlantic. The strength and location of the anomalous flow this week was such (fig. 8A) that most of the Nation had below normal temperatures (fig. 8B). Only the Southern Plains, the extreme Southeast, and a small area of the North Central States reported higher than normal temperature. A surface storm moving from the southern Rocky Mountains to the Great Lakes during this week resulted in heavy rain in the Southern Plains and the Mississippi Valley (fig. 8C). The same storm also caused heavy rain in Wyoming, southeastern Montana, and nearby areas.

REFERENCES

1. J. F. Andrews, "The Weather and Circulation of March 1963—A Marked Reversal from February," *Monthly Weather Review*, vol. 91, No. 6, June 1963, pp. 309–316.
2. J. Namias, "Persistence of Mid-Tropospheric Circulations Between Adjacent Months and Seasons," *The Rossby Memorial Volume*, Rockefeller Institute Press in association with Oxford University Press, New York, 1959, pp. 240–248.
3. U.S. Weather Bureau, "Normal Weather Charts for the Northern Hemisphere," *Technical Paper* No. 21, Washington, D.C., 1952, 74 pp.
4. U.S. Weather Bureau, "Sunshine and Cloudiness at Selected Stations in the United States, Alaska, Hawaii, and Puerto Rico," *Technical Paper* No. 12, Washington, D.C., 1951.
5. U.S. Weather Bureau, *Weekly Weather and Crop Bulletin National Summary*, vol. I, Nos. 14–18, Apr. 8, 15, 22, 29, and May 6, 1963.